

*Valvata lewisii* Currier. Found on *Chara fragilis* on the bottom of the lake.

*Lymnaea obrussa decampi* Streng. Common.

*Planorbis hirsutus* Gld. Large specimens, common.

*Planorbis trivolvis* Say. Common.

*Planorbis campanulatus* Say. Common.

*Planorbis exacuus* Say. Obtained only five specimens.

*Planorbis parvus* Say. Common.

*Physa heterostropha* Say. Small specimens.

I also revisited the Lovely Brook bog in Fort Fairfield in August 1925, and discovered a colony of *Planorbis crista* Linn., collecting about fifty specimens. The colony of *P. crista* in the Barren Brook bog, Caribou, still exists and ten specimens were obtained in August 1925. On the scanty vegetation growing on the marl bed along the water edge I found for the first time the small orchid *Liparis loeselli*. Thus I find that certain geological conditions are great factors bearing on the distribution of both the fauna and the flora.

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## MOLLUSCAN PROVINCES IN THE WESTERN UNITED STATES

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BY JUNIUS HENDERSON

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One working on the non-marine Mollusca of the Western United States is inevitably strongly impressed with the existence of a number of molluscan provinces, distinct in certain of their biological characteristics, though their boundaries, of course, are not sharply defined, and the region would perhaps be divided in different ways by different students, depending upon what particular groups of mollusks they happen to be studying. Looking at the subject in a larger way, there are some provinces upon which we may all agree.

If a line be drawn through eastern Montana, Wyoming, Colorado and northern New Mexico, thence southwestward, it will divide the United States into two major molluscan divisions. The eastern division is characterized by the abundance of numerous species of *Polygyra*, large heavy-shelled, operculate species of fresh-water univalves such as *Campeloma*, *Viviparus*, *Goniobasis*, *Lithasia*, *Anculosa*, *Pleurocera*, etc., and a large and varied fauna of heavy-shelled Unionidae. None of the fresh-water univalved genera mentioned extends at all into the western division, except *Goniobasis*, which is represented by only a very few species inhabiting southwestern Montana, northern Idaho, Oregon, Washington and northern California. *Polygyra* is absent from most of the western division, but is represented by a few forms with much the same distribution as *Goniobasis*. Heavy-shelled Unionidae of a few species are sparsely distributed in eastern Montana, Wyoming and Colorado, but do not cross the Rocky Mountains. Their total absence from North America west of the Rockies is remarkable, "this being the largest area destitute of Unio life in the temperate or tropical regions of the globe."<sup>1</sup> The family Unionidae is, however, represented in all the states west of the Rockies by the thin-shelled genera *Anodonta*, *Gonidea* and *Margaritana*. The latter extends eastward from Oregon and Washington into western Idaho and western Montana, but is absent thence eastward to Pennsylvania and northward through central British America. As *Unio*, *Goniobasis*, *Viviparus*, *Campeloma* and *Lithasia* are found in Cretaceous and Tertiary formations of the Rocky Mountain states, it is evident that their range has for some reason become restricted since Tertiary time. The two major divisions are also set off one from the other by the presence in the western area of many species of *Ashmunella*, *Sonorella*, *Oreohelix* and the group of species usually assigned to *Epiphraamophora*, *Oreohelix* crossing the line only into the Black Hills region, and the others not at all.

<sup>1</sup> Simpson, THE NAUTILUS, VIII, 118, 1898.

The western division may be subdivided into several provinces, each marked by the presence of certain genera and the absence or relative scarcity of others. For example, in the Rocky Mountain province, embracing Colorado, Wyoming, Montana, Idaho, Utah and northern New Mexico, the characteristic, conspicuous and abundant land snails nearly all belong to the genus *Oreohelix*. The presence of *Anguispira kochi occidentalis* (Martens) and *Polygyra* in Montana and northern Idaho, and of one species of *Goniobasis* and *Margaritana* in western Montana and northern Idaho, suggests affinity with the Oregon-Washington Province, but on the whole Montana and Idaho belong with the Rocky Mountain Province, as a large proportion of all the species found in those states occur also in the states to the southward, and not westward. The abundance of *Oreohelix* throughout the province suggests affinity with the Southwestern Province, but the absence of other characteristic southwestern genera emphatically vetoes that idea.

The southwestern Province, comprising central and southern New Mexico and Arizona (possibly also Nevada and eastern California), is also inhabited by numerous species and subspecies of *Oreohelix*, but is definitely set off from the Rocky Mountain Province by the presence of many species of *Sonorella*, *Ashmunella* and *Holospira*, none of which has been found in the Rocky Mountain Province except one or two species of *Ashmunella* in northern New Mexico. Because of the scarcity of ponds, lakes and perennial streams, the aquatic molluscan faunas are not so abundant and varied as in the Rocky Mountain Province.

The Oregon-Washington Province is distinguished from the Rocky Mountain Province by the nearly, but not quite, total absence of *Oreohelix*, the greater prominence of *Polygyra*, *Haplotrema*, *Goniobasis* and *Margaritana*, and the presence of *Epiphragmophora* (or *Monadenia*).

The California Province is characterized by the great development of the group of snails usually referred to *Epiphragmophora*, represented by a few forms northward

but none eastward, and by the almost total absence of *Oreohelix*, represented by only one small species on Catalina Island. *Margaritana*, *Goniobasis* and *Polygyra* extend into the state from the northward.

In the absence of insuperable faunal barriers, any attempt to establish zoological provinces very rigidly must fail. They must necessarily be very much generalized, and will break down with too detailed discussion of species, as faunas overlap. It would be interesting to know why there should be such faunal differences as are indicated for those western provinces—what barriers there may be or what there may be in the history of the migrations of species that have brought about their present distribution. It may be possible, when sufficient information is accumulated, to answer some of the questions. That the distribution of various groups is not altogether a matter of climatic conditions is quite certain, and no other environmental factor yet observed seems sufficient.

For example, *Margaritana margaritifera* (Linn.), including a northwest American color form *falcata* (Gould), is circumpolar in its distribution, having "the most extensive range of any of the Unionidae". It occurs in moist portions of western Oregon and Washington, in semi-arid and arid Idaho, Utah and Nevada, in New England, eastern British America and Alaska, as well as in Europe and Asia. Occurring under such varied environmental conditions, why should it be absent from Pennsylvania to western Montana and northward through central British America? This interesting problem has been ably discussed by Walker, who concludes that it is not, as one might suppose, because it was destroyed by glaciation and has not yet been able to re-establish itself in that region.

Again, the genus *Oreohelix*, and even some of the species, notably *O. cooperi* (W. G. B.) and *O. strigosa depressa* (Ckll.), have a great range and thrive under very diverse climatic and other environmental conditions. Both species

<sup>2</sup> Walker, "The distribution of *Margaritana margaritifera* (Linn.) in North America", Proc. Malac. Soc. London, IX, 126-144, 1910.

mentioned are found from Montana to New Mexico, and from the cool, moist regions near timber line in the mountains to the dry, often hot plains at their base, thus being adapted to a wide range of temperature and humidity. Eastern Washington, Oregon and California seem just as suitable a habitat as southern Idaho, eastern Utah, New Mexico, Arizona or Wyoming. Many parts of Utah seem just as favorable for *Sonorella* and *Ashmunella* as do New Mexico and Arizona, but if so the snails have not yet discovered the fact. Mountain streams in other parts of Montana and elsewhere in the southern Rockies seem just as favorable for *Goniobasis* as where they occur in southwestern Montana. It is likely that they crossed the continental divide from the westward by way of Yellowstone Park, in company with *Margaritana*.

The reasons for faunal provinces and for peculiarities in the distribution of species are often complex. There are many possible environmental factors that may either limit or encourage migration, and these factors interact in a very complicated fashion. There are not only many kinds of faunal barriers, more or less effective, but also many methods by which species may pass or be transported over such barriers. Land is a natural barrier to the passage of fresh-water faunas, but in some places streams flowing in various directions have their common source in an area where their headwaters are more or less connected, at least part of the time. Sometimes the lower stretches of two streams are connected during floods, affording a highway for the interchange of species. Sometimes one stream captures part of the drainage of another by headward or lateral erosion, thus making possible such interchanges. There are many known instances of the transportation of live mollusks for long distances clinging to the feathers and feet of aquatic birds.

It is certain that glaciation destroyed all life in large areas and formed temporary barriers to migration during the last glacier epoch, the Pleistocene, yet upon the retreat of the ice the same or other species promptly repopulated

the glaciated areas. Nevertheless, some cases of erratic distribution are probably the direct result of glaciation. That, however, cannot be the cause of western molluscan provinces. Mountain ranges are rather effective, but not insuperable barriers to the migration of some types of animals. Tryon, Bartsch, Goodrich and others have shown that even a fresh-water stream may be a barrier to the migration of fresh-water species. This is notably true of a river heavily-laden with sediment, such as the Missouri, but a large, clear stream may be a barrier to a species adapted to small brooks, and a swift stream may be a barrier to a species adapted to sluggish water.

It is clear, then, that in studying the problems of distribution one must know not only all the environmental factors of the present time, but must also know the more important details of the geography and environment for some distance back in the past, with the geological transformations that have occurred. All this makes the subject more enticing.

Since the foregoing was written, Dr. Pilsbry has reminded me of the close approximation of these provinces with those proposed by Binney in 1885,<sup>5</sup> in discussing the land snails only, before some very important western genera now recognized had been segregated (*Oreohelix*, *Sonorella* and *Ashmunella*).<sup>4</sup> His Eastern Province extends clear to the base of the Rocky Mountains, a little farther west than mine. His Central Province includes the whole intermountain region, my Southwestern Province plus most of my Rocky Mountain Province. His Pacific Province includes the whole Pacific Coast region west of the Sierra Nevada and Cascade Mountains, northward to Alaska. However, he divides it into two regions, namely, the Californian, from Humboldt Bay to San Diego, and the Ore-

<sup>3</sup> Henderson, NAUTILUS, XXXVII, 77-81, 1924; Univ. Colo. Studies, XVI, 1-3, 1927.

<sup>4</sup> Bartsch, NAUTILUS, XXX, 92, 1916. Goodrich, NAUTILUS, XXXV, 1-4, 1921. Tryon, Strepomatidae, XLI, 1873.

<sup>5</sup> Binney, Manual Amer. Land Shells, pp. 18-25, 1885; Terr. Moll. U. S., V, 39, 1878, with zoogeographic map.

gonian, from northern California to Alaska. Doubtless he would also have divided the Central Province, had conchological investigations in that region been anywhere near as far advanced as at present.

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MARGARITIFERA VS. MARGARITANA

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BY JUNIUS HENDERSON

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Kennard, Salisbury and Woodward<sup>1</sup> show that the well-known generic name *Margaritana* Schumacher, 1817, must give way to *Margaritifera* [misspelled *Margartifera* by printer's error] Schumacher, 1816. This is very unfortunate and will lead to much confusion, as *Margaritana* has long been used for the fresh-water mussels of circumpolar distribution. They say: "It is true that the name *Margaritifera* had been applied by Patrick Brown (Civil and Natural History of Jamaica, 1756, p. 412) to a section of the pearl oysters, but his work being pre-Linnean does not count even though republished in 1789." Though Brown, in common with other polynomialists, used generic names in a real generic sense, he was in no sense a binomialist, as he used descriptive phrases instead of specific names, and this applies to the republication as well as to the original publication of his *Margaritifera*, consequently it must be ignored and not considered a preoccupation of the name to the exclusion of Schumacher's first name for the fresh-water mussel. This seems to be an instance justifying the committee on zoological nomenclature in exercising its discretionary power by validating the name *Margaritana*.

<sup>1</sup> Kennard, Salisbury and Woodward, Proc. Malac. Soc. London, XVI, 276, 1925.